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Technical Note

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CALCULATED FORMULAS FOR CONTROLLING THE AGS CHROMATICITY

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AGS Accelerator Division Technical Note 294 documented the field measurements for a typical AGS high field sextupole. It also gave some formulas for controlling the chromaticity in the AGS based on these field values and the existing configuration of magnets in the AGS. In the summer of 1994 the configuration of the high field horizontal sextupoles was changed. Four more magnets were added so that there were horizontal sextupoles in all 12 of the Straight Sections 13. This note documents MAD calculations of the formulas to be used with the new configuration.

Chromaticity is defined in this note as the linear change in tune with the fractional change in momentum:

$$Q' = dQ/[dP/P]$$

(Chromaticity frequently is defined also as the fractional change in tune divided by the fractional change in momentum.) Recent MAD calculations give :

$$P * dQ'_X = 1.7593 * I_H - 0.5961 * I_V$$

$$P * dQ'_Y = -0.8306 * I_H + 1.2476 * I_V$$

where:

P = the momentum in GeV/c
dQ'_X = the change in the horizontal chromaticity
dQ'_Y = the change in the vertical chromaticity
I_H = the current in the horizontal sextupole string in Amperes
I_V = the current in the vertical sextupole string in Amperes.

It is convenient to record the inverse of this matrix:

$$I_H = 0.7340 * P * dQ_X + 0.3507 * P * dQ_Y$$

$$I_V = 0.4887 * P * dQ_X + 1.0350 * P * dQ_Y$$

The calculations were carried out at injection, transition, and extraction. The results agreed to the order of a per cent and are presented here as the average of the three calculations. The tune did not change enough to make the alternate definition of chromaticity matter. These calculations were for a bare, dc machine.

When the AGS operates with a large tune shift produced by strong currents in the high field quadrupoles, the beta and dispersion functions may change significantly. The product of the sextupole magnet strength, the value of the beta function at the sextupole, and the value of the dispersion function at the sextupole determines the change in the chromaticity reported above. Changing the tune may change these values by as much as 20%, and thus change the formulas given above by an equal amount.